

## STUDIES ON DEVELOPMENT OF TECHNOLOGY FOR CEREALS AND LEGUME BASED COMPLEMENTARY FOOD

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**Abstract**— The actual meaning of malnutrition is bad nourishment. This condition is generally observed when the body is divested from its minimum daily requirements of nutrition. To avoid this problem a complementary food based on cereals and legumes is developed in the present study in order to provide balanced energy source. Sorghum flour, green gram malt, ragi malt and rice flour were used as ingredients. 4 compositions viz., control, T1, T2 and T 3 were formulated and the final sample was selected on the basis of sensory analysis. The final nutritional composition of selected sample (T2) had moisture, fat, carbohydrate, protein, ash and crude fibre content as 4.70 per cent, 1.53 per cent, 75.26 per cent, 14.58 per cent, 1.83 per cent, and 2.10 per cent respectively.

Keywords: Rice flour, Sorghum flour, Ragi malt, Green gram malt, Sensory analysis, Complementary food.  
Keywords—component, formatting, style, styling, insert (key II. words)

### I. INTRODUCTION

Complementary feeding is defined by World Health Organisation (WHO) as, “a process starting when breast milk alone is no longer sufficient to meet the nutritional requirements of infant and therefore other foods and liquids are needed alongside breast milk” [1]. The consequent addition of complementary foods that is food aside from breast milk infant formula is necessary to supply infants with additional nutrients [2]. The range of age is 6 to 23 months to introduce complementary feeding with continued breastfeeding where most children reach a general and neurological stage of (chewing, swallowing, digestion and excretion) that allowed them to be fed foods instead of breastmilk [1, 3].

A good complementary food has to be rich in energy, proteins and micronutrients (specially zinc, iron, calcium, vitamin A, vitamin C and folates), free from contaminants (without toxins, pathogenic organisms or harmful chemicals), not too spicy or salty, smoothly eatable (suitable for the age), in sufficient amounts, easily available and accessible [4]. Cereals are typically low in protein and are deficient in some essential amino acids, particularly lysine and tryptophan. Legumes are rich in protein and lysine, although they are limiting in sulphur containing amino acids. The blend of cereals and legumes forms the complete food which increases the protein content of the blend and protein

quality through mutual complementation of their individual amino acids [5].

**Materials and Methods:**

The present investigation was carried out in Department of Food Process Technology, College of Food Technology, VNMKV, Parbhani during year 2020-21.

### II. MATERIALS

The good quality of Sorghum and moth bean were procured from Parbhani local market.

#### A. Chemicals and Glasswares

Chemicals of analytical grade and glasswares used during study was available in the department of Food Process Technology, College of Food Technology VNMKV Parbhani.

## B. METHODS

### Analytical methods

The Grains were analysed for the chemical composition namely moisture, protein, fat, ash, crude fibre and minerals composition were carried out as per the method given by AOAC [6]. Nutrients were analysed in duplicate and results were expressed on dry weight basis.

### C. Preparation of flours

#### 1. Preparation of sorghum flour

The sorghum flour was formulated using the method described by Ebinoluwa [7]. The grains were soaked in clean water for 8 hr and the water was decanted after soaking. The drying of grains was done in a cabinet dryer at 70°C for 8 hr. The dried sorghum was milled into flour using a laboratory hammer milling machine and the milled sample was sieved (using the 60 mesh screen) to obtain the flour. The sorghum flour was packed and sealed in polyethylene bags at ambient temperature ( $26 \pm 2^\circ\text{C}$ ) until further analysis.

#### 2. Preparation of rice flour

Rice grains were cleaned to remove extraneous material and admixture of other food grains. The grains were washed, soaked in water for 2 hr, drained, and dried in ambient temperature followed by grinding in the electric grinder to make fine flour and sieved by 80-100 mesh sieves and then packaged in airtight plastic container till further use [8].

#### 3. Preparation of ragi malt

Finger millet grains were cleaned to remove impurities and soaked in water for 12 hr. Excess water was decanted and then soaked grains were wrapped in gunny cloth and allowed to germinate for two days. Water was regularly sprinkled during germination to keep grains moist. Sprouted grains were kiln in drier, rootlets were removed, decorticated and powdered as indicated by Shobana and Malleshi [9].

#### 4. Preparation of green gram malt

The green gram seeds were cleaned by washing three times in excess distilled water. Then, the green gram seeds were soaked in a volume of water three times the weight of seeds (3:1) in a container at ambient temperature for 12 hr. The steeping water was removed off and the soaked green gram seeds were washed twice using distilled water to avoid the growth of microorganisms during sprouting. To stimulate sprouting, the soaked seeds were wrapped in damp muslin cloth. The green gram seeds were allowed to sprout for 24 hr time. The content was left in ambient conditions and water sprinkled on it 2–3 times a day to enhance the speed of sprouting process. The sprouts were dried overnight at room temperature under a fan. The sprouted grains were ground in an electric grinder and converted to fine powder and sieved by 80–100 mesh size as explained by Bazaz and others [10]. But only change was made that the sprouts were dried in cabinet drier at 60–65°C for 6–8 hr to speed up the controlled drying.

#### 5. Roasting

The slight roasting of all prepared flours was done at 70–80°C on a low flame to avoid burning of flour before storage. Roasting gave a pleasant flavour to flours [11].

Standardization of recipe for complementary food  
Table 1: Standardization of recipe for complementary food

	Ingredients		Quantity (g)	
	T0	T1	T2	T3
Sorghum flour	85	50	40	30
Rice flour	0	20	20	20
Ragi malt	0	10	15	20
Green gram malt	0	5	10	15
Sugar	15	15	15	15
T0 = 85% sorghum				

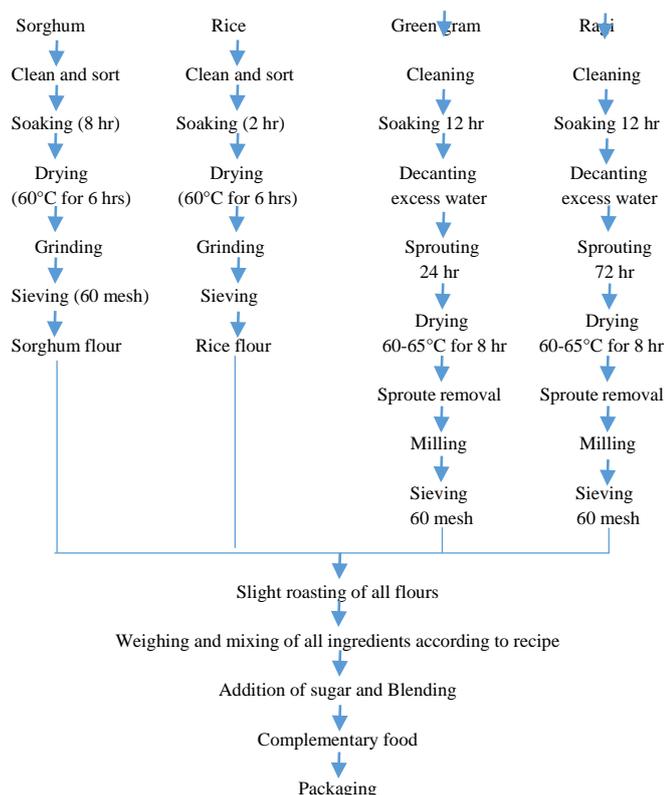
T1 = 50% sorghum + 20% rice + 10% ragi malt + 5% green gram malt

T2 = 40% sorghum + 20% rice + 15% ragi malt + 10% green gram malt

T3 = 30% sorghum + 20% rice + 20% ragi malt + 15% green gram malt.

### E. PREPARATION OF COMPLEMENTARY FOOD

The complementary food was formulated by blending roasted flours of sorghum, rice, ragi malt and green gram malt at different ratios. The most suitable preparation method by point of view of all angles like production, nutritional value organoleptic characteristics and durability was selected.



Flow-Sheet 1: Preparation of cereals and legume based complementary food

#### F. SENSORY EVALUATION OF COMPLEMENTARY FOOD

Sensory evaluation of complementary food is done by 5 members. The product for further analysis was selected on the basis of sensory evaluation. Sensory evaluation done by using 9 points Hedonic scale by 5 trained panel members.

Samples	Colour	Flavour	Taste	Mouthfeel	OA
T0	7.8	7.5	7.8	8.0	8.0
T1	7.6	7.8	6.9	7.6	7.4
T2	7.9	8.0	7.8	8.1	8.2
T3	7.2	7.3	7.2	7.5	7.3
SE	0.22822	0.16667	0.20412	0.21246	0.1559
CD					
@5%	0.94275	0.68849	0.84322	0.87765	0.64402

\*Each value is average of three determinations

Where,

T0 (Control) = 85% sorghum

T1 = 50% sorghum + 20% rice + 10% ragi malt + 5% green gram malt

T2 = 40% sorghum + 20% rice + 15% ragi malt + 10% green gram malt

T3 = 30% sorghum + 20% rice + 20% ragi malt + 15% green gram malt

All 4 samples T0, T1, T2 and T3 the scores for color and appearance were 7.8, 7.6, 7.9 and 7.2 respectively. For samples T0, T1, T2 and T3 the scores for flavor parameter are 7.5, 7.8, 8.0 and 7.3 respectively. For samples T0, T1, T2 and T3 the scores for taste parameter are 7.8, 6.9, 7.8 and 7.2 respectively. For samples T0, T1, T2 and T3 the scores for mouthfeel parameter are 8.0, 7.6, 8.1 and 7.5 respectively. For samples T0, T1, T2 and T3 the scores for overall

acceptability parameter are 8.0, 7.4, 8.2 and 7.3 respectively. Similar observation with respect to attributes colour, flavour, taste, mouthfeel and overall acceptability of complementary food was reported by [12].

For all parameters T2 scored highest and so that it is selected for further analysis purpose. The Standard Error (SE) and Critical Difference (CD) values were calculated. There was significant difference among the samples in context to all the sensory parameters. Overall, by considering the different sensory attributes, the formulation T2 was found to be superior than the other samples and selected for further study.

#### G. PROXIMATE COMPOSITION OF PREPARED COMPLEMENTARY FOOD

The formulated samples were analysed for the chemical composition namely moisture, protein, fat, ash, crude fibre were carried out as per the method given by AOAC [6]. Nutrients were analysed in duplicate and results were expressed on dry weight basis. Following results obtained.

Table 3: Proximate composition of complementary foods

Chemical parameters	Values (%)	
	T0	T2
Moisture	4.81	4.70
Total fat	1.69	1.53
Total protein	9.90	14.58
Total carbohydrates	79.80	75.26
Crude fibre	2.12	2.10
Ash	1.68	1.83

\*Each value is average of three determinations

The selected sample (T<sub>2</sub>) has moisture, fat, carbohydrate, protein, ash and crude fibre content as 4.70 per cent, 1.53 per cent, 75.26 per cent, 14.58 per cent, 1.83 per cent, and 2.10 per cent respectively.

The data presented in Table 3 depicted the proximate composition of various formulations of complementary foods. The moisture content was found to be decreased slightly in the complementary food after addition of green gram malt. The moisture content of control sample was 4.81 per cent and that of selected sample was 4.70 per cent which is less than control sample. Results reported are in close agreement with results obtained by Ibranke and others [13]. The developed complementary foods fulfill the recommendation of Bureau of Indian standard (2006) that the moisture content did not exceed the 5.0 per cent.

The fat content of sample T0 was higher (1.69 per cent) than T2 (1.53 per cent). The results for protein content of complementary foods were found to be increased with incorporation of legume (green gram). It can be observed that the maximum value for protein content was found for sample T2 (14.58 per cent) whereas, the lower value was recorded for control (9.90 per cent). The sample T2 containing 40 per cent sorghum, 20 per cent rice, 15 per cent ragi malt and 10 per cent green gram malt was significantly superior than other formulations of complementary food. Similar pattern was observed in [14, 15].

From the Table 3 data showed that, there was noted increase in carbohydrate content in formulation containing high proportion of sorghum in complementary food. The maximum carbohydrate content was found in control sample (79.80 per cent) Whereas, the minimum value was recorded for T2 (75.26 per cent). Results reported are in close agreement with [13].

Data related to the fibre content of complementary foods not showed any significant change. The trend of decreasing fibre amount in various formulations was observed due to the contribution of fibre into the product by its raw material used. Findings are well supported by [16]. Since fibre content of foods help in digestion, prevention of constipation and the prevention of colon cancer [17].

Results showed that the ash content was varied slightly among T0 and T2 was from 1.68 to 1.83 per cent. This addition observed due to addition of malts. Ash content is reflective of the total mineral content present in the products. Results reported are in close agreement with [14, 15].

The energy value of selected complementary food (T2) was calculated and value 373.13 kcal/100g recorded. This shows that prepared product has good energy value.

### III. CONCLUSION

The combination of cereals and legumes provides the complete nutrition through complementary foods. The good amount of energy (373.13 kcal/100g) is provided by developed product. Protein value is also high.

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